

THE

ENGLAND). — COMMITTEE OF LANDOWNERS, ETC.

(16)

# R E P O R T

OF

JOHN WATTE,

SURVEYOR AND ENGINEER,

For the better Drainage of the South and Middle Levels  
of the Fens, and other Lands bordering upon each Side  
of the River Ouse, and amending the Outfall of the  
said River, by a New Cut or Channel from Eau-Brink  
to Lynn.



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T H E

# R E P O R T, &c.

**I**N pursuance of an Order to me directed from seevral gentlemen, proprietors of lands in the South and Middle Levels of the fens, called Bedford-Level; and of those lands in the County of Norfolk, bordering upon each side of the river Ouse;

By which I was desired to take the fall, levels, soundings, &c. of the said river and channel, from above St. German's Bridge, to a certain place in the haven, or bay,

called the Crutch, about two miles below the Port of Lynn; and to give my opinion in respect to a new cut or channel (formerly proposed by Mr. Kinderley) to be made from a place called Eau-Brink, about three quarters of a mile below St. German's Bridge, across the lands, to about a quarter of a mile above Lynn-Harbour; and what effect such cut or channel might have upon the drainage of the said Levels, Marshland, and other lands, bordering upon (and draining into) the river Ouse; and how far it might prove salutary or detrimental to navigation up and down the said river, and to the Harbour of Lynn;

In consequence of such instructions, I proceeded upon the business in the latter end of March, 1791, beginning at St. German's Bridge, and took the soundings or depths of water in the said river at low-water, upwards to Polver's Goole, above St. Peter's Church, and found it to be from six to eleven feet and a half deep, except where the current sets across the channel, and casts up sand-banks and shoals, at which place it was from four to four feet and a half deep. From St. German's Bridge I took the soundings downwards to the Crutch, and found the water was of various depths, from sixteen inches to fifteen feet, as appears by the line and scale of levels, with the soundings herewith delivered.

The river above St. German's Bridge, and to about four furlongs below the same, is confined by jetties; and is in width about two hundred and seventy-five feet. The bridge has a water-way of one hundred and sixty-six feet.

From

From Eau-Brink to a little above the Port of Lynn, the channel was from sixteen inches to fifteen feet deep, unconfined, and running in a serpentine course, between banks placed from one to six furlongs asunder, through high shifting sands and shoals, so that it is continually changing from one side to the other, as the flow and ebb of the tide, or a rough sea, operates; the current cheques in from one shore to the other; and, setting hard against the banks, forms eddies and pools under the same, fifteen, and sometimes twenty, feet deep at low water. In stormy weather and spring tides, the water from so expanded a surface being agitated, dashes violently against the banks, so lacerates and tears them that they are in imminent danger of breaches, and rendered so very expensive to maintain, that some parts thereof can scarcely be supported by the income of the lands they are made to defend.

From a little above the Port of Lynn, and through the harbour, the channel was wide, and in some places very shallow, and is frequently changing by the setting of the current, and, I understood, was often nearly choaked by the sand-banks and shoals thrown up or brought there by the tide, on its influx and reflux, particularly where it sets over or crosses the harbour from the place where the ships usually lie, to West or Old Lynn; from thence it continued under the Western shore past the Ferry Staith, down to where the bank turns off for Terrington Marshes, and then it ran by the Green Marshes and through the sands in a curved direction, and very shallow, to the Crutch, at which place it was of a more equal depth and deeper water,

water, though still running between sand-banks quite down to the Bar Beacon, and so to sea. In passing through Lynn Harbour, I found the same to be very wide, and much incommoded with high shifting sands, extending quite into the middle thereof, which render the navigation extremely hazardous, particularly about the place where the Channel crosses; and on such moveable sand-banks vessels, whose pilots are not perfectly acquainted with the navigation, or in stormy weather and a rough sea, are sometimes overset, of which there has been recent instances.

On my proceeding down the river, I made the following observations: at the Gooles, or outfall sluices, as I passed by, viz. at the Goole called Polver's Goole, there was but little run of water into the river, and the border-lands, which drain thereby, were much overflowed, nearly up to the hard-lands. At the Goole called St. Mary's Goole, below St. German's Bridge (lately erected), the water ran through the same, for a few hours before low water, in a languid manner, and near Saddle-Bow some of the lands which drain through it were wet and soak, the water in the ditches being equal with the surface thereof. At the Gooles called Knight's Gooles, erected for the drainage of the greater part of Marshland, I found the water to run, a few hours before low water, with but a slow current, across the shifting sands to the channel. I understood, that after high tides with stormy winds, they are frequently choaked up, and run but little for days together, even at the lowest water; but when the land-floods, or freshes, come down, the water, for weeks together, is known to run from two to two feet nine inches higher at low water than when I

took the soundings. During that period, there is not the least water passes to sea, but lies upon the surface of some thousand acres of as prime land as any in the kingdom which drain this way, to the great damage of the same, and injury to both the proprietors and occupiers thereof; as I understood at the time I took these minutes, the water was near a foot deep upon several acres of the high or inside lands, and from two to four feet deep upon the lands called Marshland Fen. The water was deep upon the floor, or sea apron, of the Lower Goole 5 feet 10 inches, and had fallen during the course of the spring only about nine inches at the tail or land side thereof; a pitiful outfall indeed for the drainage of five-and-thirty thousand acres of land!

Tilney and Clenchwarton Gooles, which open into the channel lower down, I found much incommoded with sands, and nearly choaked up; but as the lands draining through them (about four thousand acres) lie very high, they may, with industry and great expence in cleaning the strings or outlets, by hand, at certain times of the year, make shift to get rid of their waters this way; but I am certain they would have a much better outfall, were the drains carried within side the bank, down to Old Lynn.

From the above observations it appears, that both drainage and navigation by this river are reduced to a deplorable state, and I fear are getting worse, by the sand-banks and shoals continually rising, which manifestly appear by the outfall of Marshland and other drainages, as ten or fifteen years ago they were in a much better state; and if we may argue from analogy, and infer from consequences,

what

what has been gradually growing for that number of years past, what state of drainage may we expect the country to be in ten or fifteen years hence? and what in a longer period, if nothing effectually be done to improve and secure the outfall to sea? as wind-mills, the last effort, and the only expedient at this time that can give relief to the low lands, I fear also must be deserted ere long, as they are now got to the last degree in size, if not improvement. But provided that such an artificial (at the best uncertain) drainage could be carried on for a series of years at a tolerable expence, I beg leave to ask in what competition does it stand to a natural one by a certain and good outfall? The censure of the one or an eulogium on the other, it will be needless for me here to insist upon as absurd, and would be considered as an attack upon the good sense of mankind. Low-water-mark in this river is gradually getting higher: and in time, it<sup>1</sup> is my opinion, that the waters without, frequent land-floods happening, will not be able to force their way to sea through the sands and shoals, they being often divided, and in the last quarter's ebb run so languidly and shallow, as to lose all power of grinding. Such low-water-mark I understand, from good authority, is now three feet higher at Denver-Sluice than it was in the year 1777, when Mr. Golborne made his observations and report.

The above being mostly from observations made on the water, I now proceed to those made upon the land; that is to say, the line of levels, or falls, taken from St. German's Bridge to Eau-Brink, from thence across the lands in a straight direction, to Lynn channel, or harbour, about two furlongs above the town, or to a place where

the proposed new cut, or channel, would fall into the present one, and from thence down to the Crutch ; but the latter part was not taken in quite so regular a manner as the former, owing to the quick-sands and other impediments.

The said levels were taken from low-water-marks, made at the water's surface in small spring tides, when there was not the least land-flood, or fresh, in the river, which I found to vary but little from those taken in the neaps, so that it was not the most favourable opportunity to gain the greatest fall : such water-marks were taken at the same instant by persons appointed at the several places : and that part of the line of levels from German's Bridge to above Lynn, was taken forward and backward by a very accurate instrument ; and, to shew the accuracy of the same, there was only one inch and seven-tenths difference in the operations of fifty-eight stations (or in placing the instruments so many times); so that any calulations, report, or opinion, may safely be grounded upon the **FALL** as given by those levels, without the least doubt or suspicion of being betrayed into error thereby. Thus much I thought well to premise, it being the foundation, or basis, on which that most important superstructure is to be erected, viz. the *salvation* of a long-neglected *country*, by the drainage of three hundred thousand acres of inundated lands !

It appears from the said levels, that there is a fall from German's Bridge to Eau-Brink of six inches, being six furlongs, or three quarters of a mile ; from thence across

the land in a straight direction to a little above Lynn Harbour, I find the fall to be four feet ten inches and four-tenths, the distance being two miles and three quarters; and from thence to the Crutch, the fall is two feet and six-tenths of an inch, the distance being three miles; so that there is a fall of water, in the distance of six miles and an half, of seven feet five inches, a *fall* more than sufficient (if acting in a confined channel) to lower the surface of low-water at German's Bridge, four feet and an half, as will appear by the following illustration: It is universally allowed, by those who have made the doctrine of fluids their study, that three inches fall in a mile will produce a brisk current in a stream or river, but doubtless a fall of four inches in a mile will produce one much more so; so that allowing four inches in a mile for the current, from German's Bridge to Lynn, where the channel is intended to be confined, viz. three miles and an half, will make fourteen inches; and allowing in the other three miles six inches per mile, will be eighteen inches (together two feet eight inches); which, taken from seven feet five inches, the whole fall, leaves *four feet nine inches*, and so much would low-water-mark be lowered at German's Bridge, by turning the river down a straight cut or channel.

Nearly the same would take place at Denver, and Salter's Load Sluices, as well as the rivers freely communicating with this, and would be proportionably felt at the outfall of every drain throughout the said South and Middle Levels. It would be a certain drainage to all those border-lands which have their outfalls into the river Ouse below Denver

ver Sluice ; and would prove effectually so to that valuable tract of land called Marshland, except the low parts of the fen, the drainage of which could easily then be compleated by the assistance of an engine-mill.

I would therefore recommend the deserting of the present channel (making a dam across the same), and the opening of a new cut, or channel, from Eau Brink, across the old lands and marshes, to about two furlongs above Lynn ; the said cut to be made at the upper end of the width of the present river, a little below German's Bridge, and the lower end to be wider (to give an adequate indraught to the tides), to have banks formed at a proper distance on each side thereof, with the earth coming out of the same, and to have two piers at the mouth or entrance thereof from the sea, made with rag or other common stones. But in the execution of it attention should be had to the soil or materials it would be carried through ; as if it be composed of strong clay, it should be made in the first instance to the width and depth intended, the bottom should be formed with a declivity, and at least six feet lower than the low-water-line. But if it should be found a silt or sandy soil, it would not be necessary to take those precautions ; as with proper care, and the use of the spade machine, it might be ground down to any depth required.

By the making of such new cut, and turning the channel, it would prove of very great advantage to those who have banks to support against the present channel below Eau-Brink, which heavy expences, in a little time, they would be relieved

leased from. The said channel in a few years would be quite silted up, and become good and firm land, the sale of which would in great measure pay the purchase for lands used in the new cut, its banks, and forelands, or the money arising by such sale might be applied generally to the payment of any other debts that were contracted in carrying the said proposed works into execution.

The use of the spade machine I would also recommend in the rivers above, to take down the sand-banks or shoals; and have but little doubt, by such management after the cut were made, of grinding down the bottom of the River Ouse, to lower or reduce the water's surface equal to that at Lynn at this time, or five feet and a half lower at German's Bridge than it now runs. This is from opinion; but the above reduction of *four feet nine inches* is deducible from mathematical observations, physical truths, and stated facts.

What makes me more fixed in my opinion, is by a recent and similar instance, by a like cut made at the outfall of Wisbich River, which has had all the *desired* effects, though the undertaking had not that apparent certainty, nor was it of equal magnitude, with this; and, from certain and known facts, I can speak to the same, as, before it was executed, I was called upon by the Commissioners of Tid and Newton drainage, to take the levels from their outfall sluice to Gunthorpe Sluice, when the water was deep upon the floor, or sea apron, of Gunthorpe Sluice, seven feet, during the winter season, at low water; and in the year 1782, I was called upon by the

Commissioners of the Bedford North-Level to take the levels and soundings of Wisbich River, from Peterborough bridge down to Gunthorpe Sluice, at which time the water ran six inches deep upon the said floor, viz. six feet and a half lower than it had done for several years preceding the making of the said cut.

This cut was also proposed by the same Mr. Kinderley some years ago, and was made from a place called the River's End, to carry the channel through the Green Marshes, about a mile and a half in length, to avoid the moveable sand-banks and shoals in the Bay it passed through on the Norfolk side thereof; and which had the proposed effect of lowering the waters at Gunthorpe Sluice (the outfall for the North-Level, Portsand, part of Sutton-Holland, and other waters) six feet on the first opening of the works; which prodigious fall gave immediate relief, and secured the drainage of the above and other valuable tracts of land, draining by the said river, and rendered a distressed and almost desolate country, once again flourishing, to the then great comfort, and the present enriching, of numerous families, as well as an acquisition of some thousand pounds *per annum* to the community at large. It had also the most salutary effect on the navigation to the port of Wisbich, which town it relieved from its depressed state, and rendered it again respectable, and it is now for its magnitude as flourishing a place in trade and commerce as most in the kingdom.

The effect which the proposed cut would have upon the navigation in the River Ouse, would be of great importance to trade, as shortening the distance would accelerate the passage of the craft going thereby to and from Lynn, and render the same safe at all times. They would then be conducted by a channel sheltered between banks, and not liable to be exposed to the violence of the winds and tides, and danger of the sand-banks, which now attend the navigation through that dangerous river (or rather bay) from Lynn to St. German's, where merchants and traders meet with so many disasters, losses, and frequent delays, that trade is now carried on thereby with great hazard, much difficulty, and considerable expence. As to any idea or fear the traders may have of the craft being rendered unmanageable by the rapidity of the current, would be extinguished a little time after the intended cut or river were opened, particularly if a land-flood, should quickly follow, as the current shortly after that would run smoothly, or in the same manner the upper part of the river about German's Bridge now does. The effect it might have on the harbour of Lynn, I cannot conceive would be attended with any of the dangerous consequences as some are so much alarmed at; but, on the contrary, would be of great use thereto, if the waters coming through the cut were properly pointed down the channel, through the harbour, and exertions used to assist it by throwing out jetties, &c. at proper places; by such means, there would be a great probability of bringing the channel along by the town, at such distance as desired, and to fall down to the Crutch in nearly a straight direction. As to the danger of the current raising sand-banks

banks or bars across the channel, as seems to have been suggested by some, I cannot by any means agree to ; it not being like a head of water held up by a sluice, or reservoir, for a scour only, which, when let off for want of a continued back water, goes off with a flash only, and often produces the effects alluded to, of blowing deep holes or pools just below the outlet, and, by its expanding and growing weaker as the distance increases, lets fall again those particles of sand and soil it is surcharged with, and there forms bars or banks ; but, in this case, the waters passing through the cut or new channel would have a different effect, as the shortening of the indraught of the tides, and reducing the low-water-mark ; the tides therefore would flow much quicker, consequently higher up the rivers than they now do by several miles, and would form a deep and large column or body of water that would descend upon every ebb with a great force or *momentum* (by then it got into this harbour) that would continually grind and scour the bottom of the channel, and take away with it all those particles of sand or sediment that might be brought in with, or deposited by the tide during its flow. It may be asked, if the tides were to flow higher up the rivers, would not the banks above the cut be in danger of being overflowed ? In answer thereto, I do not mean by the tides flowing higher up the rivers, that they would flow higher against their banks *in that degree*, as may have been supposed by some, but that they would certainly flow something higher in still tides against the banks above than they do now, by reason that the distance from the bay would be shortened, consequently they would require less time (with the same velocity they run with now) to come to or reach any as-

signed point in the river above ; therefore, the impulse from the sea would not be withheld whilst the tides were further advanced up the river than they now are ; as the climbing over the sand-banks, by the friction against the bottom of the present channel, and the distance also considered, must retard their motion at least three quarters of an hour in running up to German's Bridge. But I think high tides, accompanied with violent winds, do flow (as this river or bay is circumstanced) at that place and above it, nearly equal in height or to the same level with the sea now, as they would then ; in consequence thereof, the banks above would be in no more danger of being overflowed after the cut was made (upon the dangerous tides) than they are at present ; but this I think would admit of a demonstration, if it should hereafter be found requisite.

I submit the foregoing observations and opinions with due diffidence, hoping my employers (and all others whom it may concern) will excuse the manner in which they appear, as, from the hurry of the business, had not time methodically to arrange them, and treat of the matters herein contained, in the manner I could have wished, and which the importance of the subject demands.

Wifbich,  
April 21, 1791. }

JOHN WATTE.

Soundings

( 19 )

Soundings of the River Ouse, and Channel, from a little above  
 St. German's Bridge down to the Crutch in the Bay, below  
 the Port of Lynn, taken at Low-Water, in the latter End  
 of March and the Beginning of April, 1791.

Furl.	Downwards.	Feet.	Inches,	Furl.	Downwards.	Feet.	Inches.
0	At German's Bridge,	16	0	39		1	4
1	Below D <sup>o</sup>	6	0	40	(Five Miles)	6	5
2		5	9	41		7	8
3		6	5	42	Against Clenchwarton-Goole,	3	5
4	Against St. Mary's Goole,	6	1	43		3	0
5		9	0	44		3	2
6	Turn of the River,	8	9	45		3	6
7		9	4	46		3	1
8	(One Mile)	5	9	47		4	2
9	Against Cullen's Stile,	6	6	48	(Six Miles)	4	5
10	Opposite Mr. Lane's,	8	9	49	Bank Corner, to Old Lynn,	3	5
11		7	6	50		3	0
12		6	0	51	At the proposed Cut End,	3	0
13	Against Knight's lower Goole,	4	0	52	Along by where the Ships lie,	3	0
14		4	5	53		3	0
15		7	6	54	Where the Channel sets over or crosses,	2	4
16		4	6	55	Under the Western Shore,	9	6
17		4	4	56		10	0
18	Opposite late Mr. Dixon's,	4	8	57		5	10
19		4	10	58		2	6
20		4	10	59	Ferry Staith at Old Lynn,	5	4
21	Against a Granary,	12	0	60	Opposite the Town's End,	4	0
22		5	9	61	On by the West Bank,	4	3
23		3	6	62		8	3
24		3	0	63	At Corner of Bank,	8	3
25		6	6	64	(Eight Miles)	8	0
26		4	0	65	On by the Salt Marsh,	3	8
27	Opposite Tilney Goole,	4	9	66		4	2
28		5	3	67	At leaving Salt Marsh,	4	0
29		3	6	68	Through the Sands,	4	8
30		3	6	69		3	8
31		3	6	70		3	8
32	(Four Miles)	3	6	71		3	6
33	In an Eddy on the West Side.	15	0	72	(Nine Miles)	3	2
34		4	0	73		3	4
35		3	4	74		3	10
36		3	0	75	At the Crutch,	6	9
37		2	8	76	Below the same,	7	4
38		2	0				

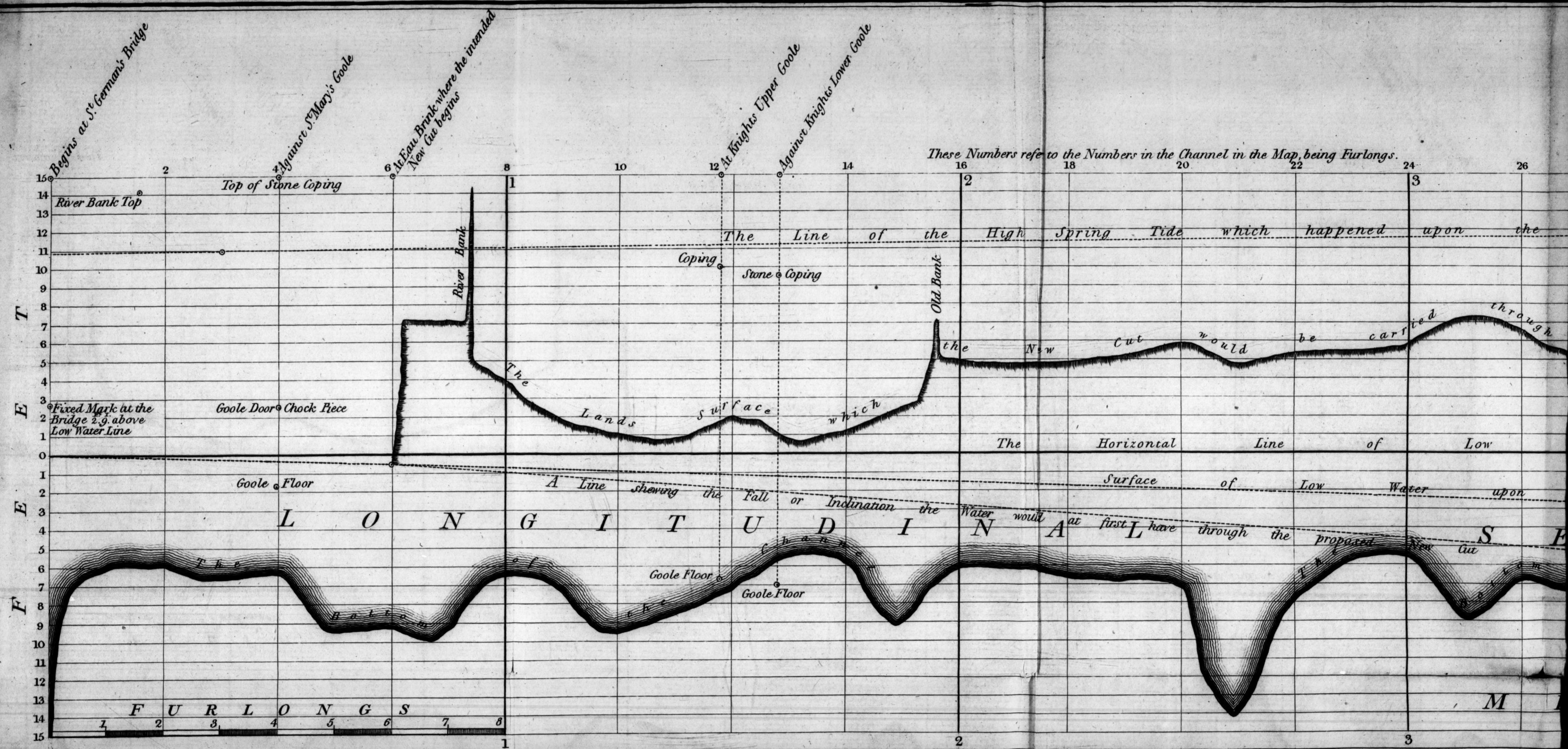
Soundings of the River upwards from German's Bridge to  
Polver's Goole.

	Upwards.	Feet.	Inches.
At the Bridge,	—	16	0
Just above, as the Distances were not taken,	—	11	8
The Current sets over,	—	4	0
Against St. Peter's Goole,	—	9	0
Against the Church,	—	6	6
Above D <sup>o</sup>	—	11	6
Against Polver's Goole,	—	9	8

Note, The above soundings were taken after a wet winter, or (from information of watermen who navigate on the said river) it would not have been near so deep below Eau-Brink, by several inches in general, and in some places by feet.

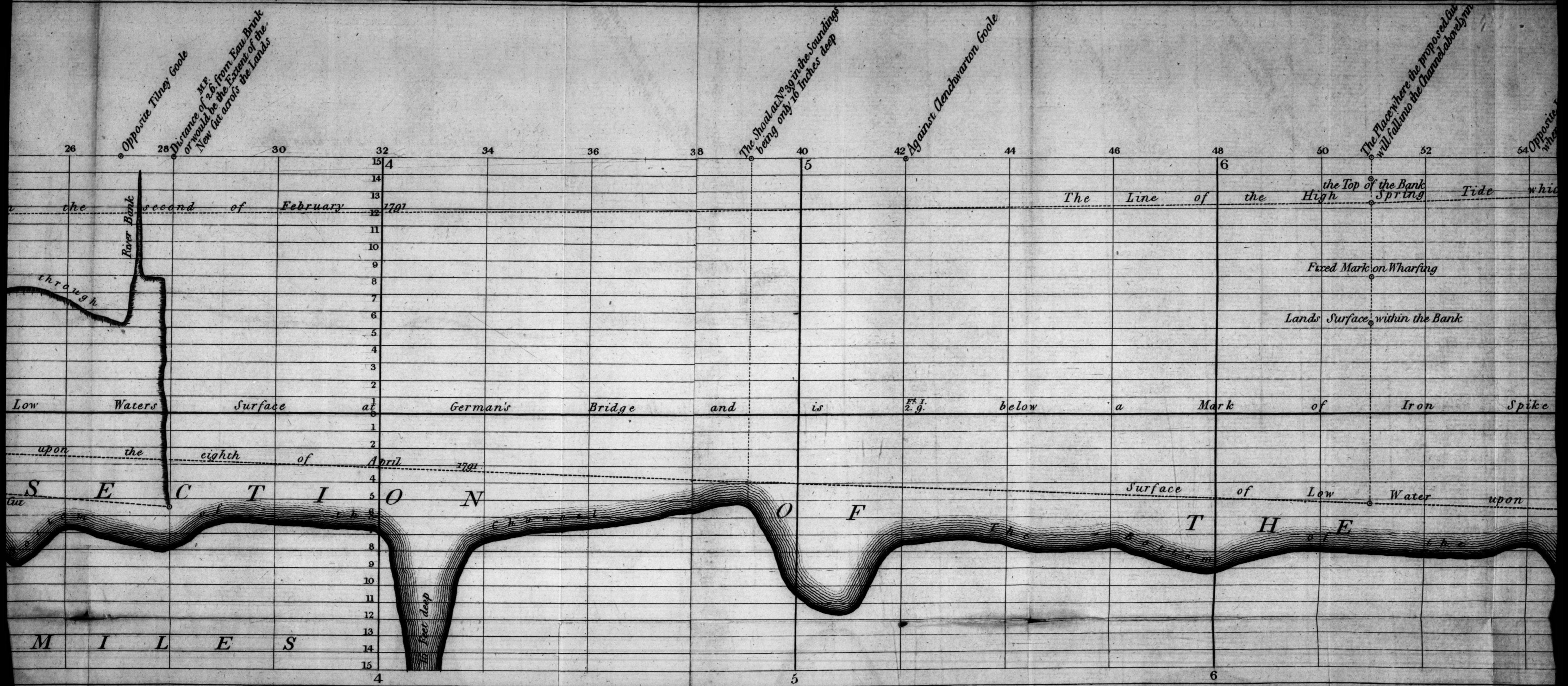


# *A LINE and SCALE of LEVELS along the present Channel*



*Note. The Distances, and Falls, are not laid down by the same Scale, as the Distances.*

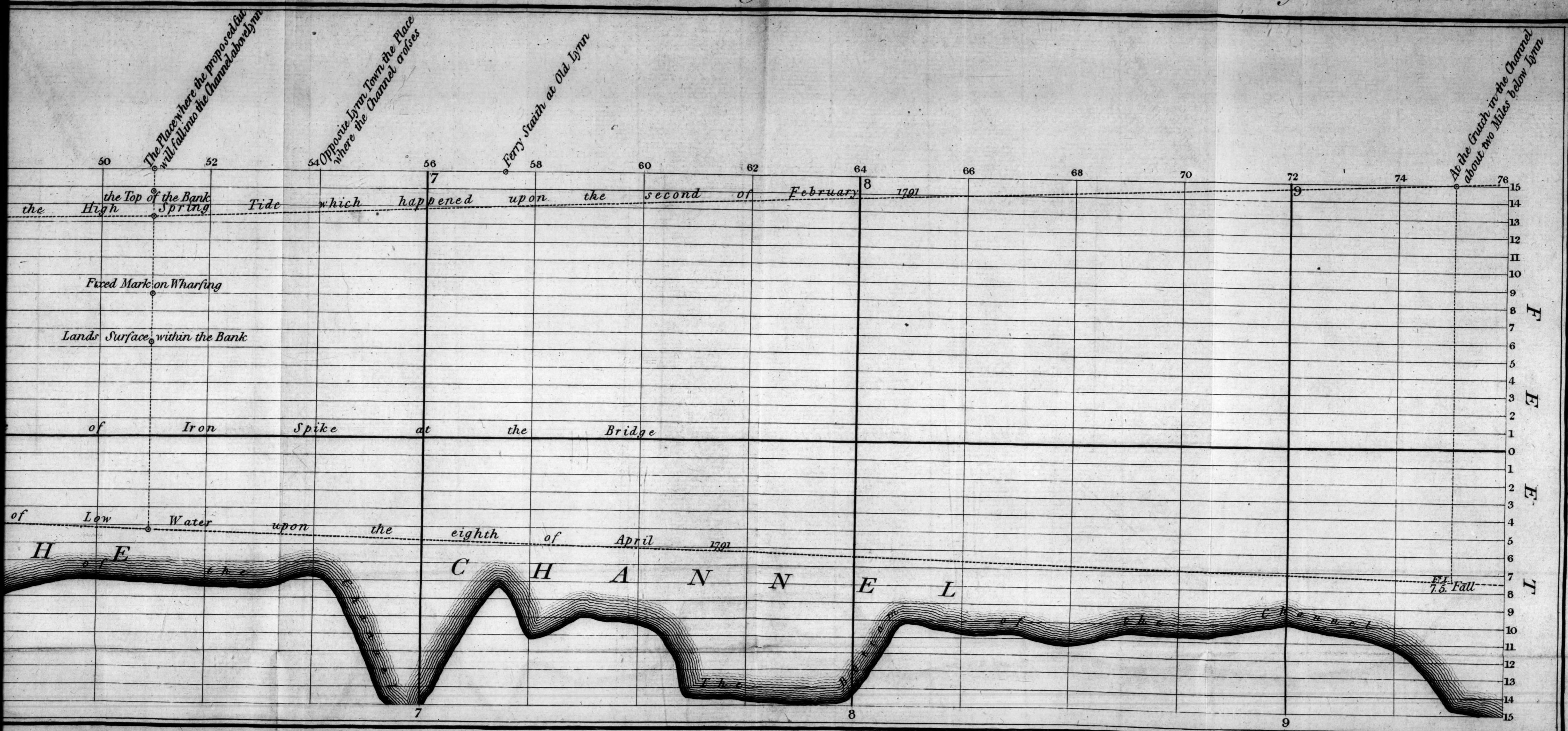
channel of the RIVER OUSE, from S<sup>t</sup>. German's Bridge to the Crutch, about two



as the Distances are, in Miles and Furlongs, and the Falls, in Feet & Inches, which makes the Bottom of the Channel appear more irregular or distorted than it really is, and which could not be avoided, as they could not be expressed, or laid down by one and the same Scale, unless the Scale

the Crutch, about two Miles below the PORT of LYNN.

taken in the Year 1791, by John Watté.



expressed, or laid down by one and the same Scale, unless the Section had been made enormously long.